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DIVISION OF FOREST PEST CONTROL

Northeastern Area State & Private Forestry

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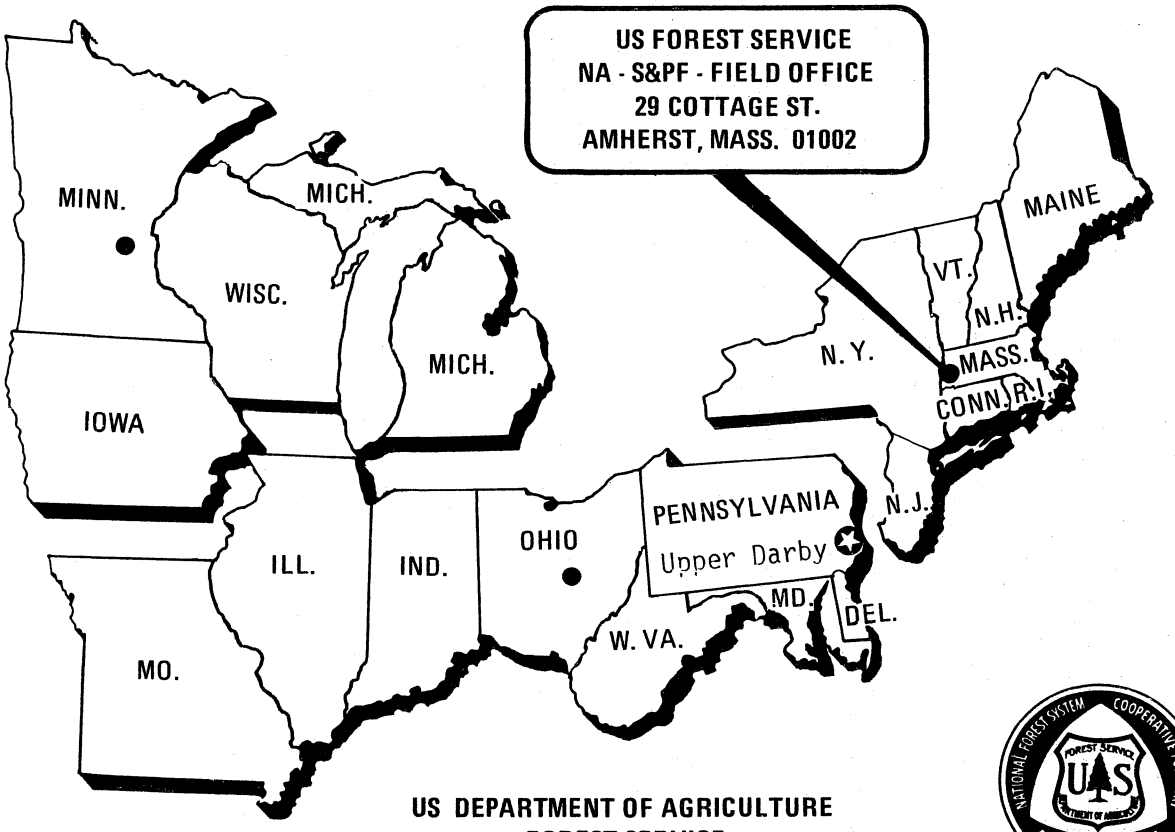
MAPLE BARK SCALE WORKSHOP

Rutland, Vermont

December 2, 1969

James S. Hadfield



US DEPARTMENT OF AGRICULTURE
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INTRODUCTION

A Maple Bark Scale Workshop was held December 2, 1969 at the Vermont Department of Forests and Parks Office in Rutland, Vermont. Sixteen representatives from state and federal agencies attended to discuss the maple bark scale and to decide future courses of action.

Although several agencies have worked on this insect for four years, the information collected remained scattered. The primary objective of this meeting was to consolidate all information known about the scale.

The following people attended the Workshop:

Alfred Avery	N. H. Dept. of Resources & Economic Development
Arthur Mason	N. H. Department of Agriculture
E. Bradford Walker	Vermont Department of Forests and Parks
H. Brenton Teillon	Vermont Department of Forests and Parks
Elwin Leysath	Vermont Department of Forests and Parks
John Risley	N. Y. State Conservation Department
William Buzzard	N. Y. State Conservation Department
Robert Mackinder	USDA - Forest Service, WMNF
John Alcock	USDA - Forest Service, GMNF
John Maslack	USDA - Forest Service, GMNF
Wayne Kingsley	USDA - Forest Service, GMNF
David Houston	USDA - Forest Service, NEFES, Hamden, Conn.
John Chansler	USDA - Forest Service, Amherst Field Office
Vaughan McCowan	USDA - Forest Service, Amherst Field Office
Robert Ford	USDA - Forest Service, Amherst Field Office
James Hadfield	USDA - Forest Service, Amherst Field Office

DISCOVERY

Maple bark scale was first discovered on November 4, 1964 by Norman Hudson, Washington County Forester, in Plainfield, Vermont. No attempt was made at that time to identify the scale. The insect was "rediscovered" in August 1965 near Pittsfield, Vermont, by a logger, Mr. Joseph Andrews. At approximately the same time the scale was reported in New York. Efforts were made to have the scale identified at that time.

DESCRIPTION

Maple bark scale was described as a new species Cryptococcus williamsi by Michael Kosztarab and Dreamer L. Hale, Department of Entomology, Virginia Polytechnic Institute, Blacksburg, Virginia. Descriptions of the adult female and first-instar nymph were given.1/

The mouthpart measurements given by Kosztarab and Hale were questioned at the Workshop. A comment was made that it would be very difficult to remove a scale from a sugar maple without breaking the delicate mouthparts. The drawing of an adult female scale provided by Kosztarab and Hale does, however, show intact mouthparts. Measurements given for the mouthparts are an average of 50 microns in length with a range of 31-86 microns. Several inaccuracies in the discovery history by Kosztarab and Hale were pointed out by the attendees.

LIFE CYCLE

Only female scales have been found. Crawlers are found in spring and early summer. There is contradiction about the method by which the crawlers are born. Arthur Mason, Assistant State Entomologist, New Hampshire Department of Agriculture, observed that the females lay 20-30 eggs which hatch 10-15 minutes after being laid. E. Bradford Walker, Chief, Forest Pest Control, Vermont Department of Forests and Parks observed the crawlers to be born alive. A suggestion was made that perhaps the eggs hatch immediately upon being laid.

After birth, the pink crawlers move about the tree stem in search of a niche. Some are probably blown to surrounding trees by wind at this time. After finding a suitable niche, the crawlers settle

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1/ Kosztarab, M., and D. L. Hale, 1968. A new Cryptococcus species from North America with a key to the species of the genus (Homoptera:Coccoidea). Virginia Jour Sci 19(1):7-12

down, insert their mouthparts, and lose their legs. A covering of white wax is produced by the scales after losing their legs.

Wax production seems to be most active in the late summer and fall. The wax is frequently washed off the adult scales during the winter months.

HABITAT

Maple bark scale exhibits a very definite preference for sugar maple. The scale has been observed once on a red maple in Bartlett, New Hampshire.

The insect has been found on maples at elevations from 300 - 3,000 feet. Aspect seems to have no influence on the incidence of infestations in a stand.

Maple bark scale has been found both in mixed and pure stands of sugar maple. A comment was made that infestations are more prevalent in stands with little or no underbrush.

Bark thickness seems to be a major factor limiting infestations of the scale. As was previously mentioned, the mouthparts average 50 microns in length. Most sugar maples have bark much thicker than this. Smooth, thin-barked trees or trees with bark just beginning to crack have heavier infestations than trees with rough, thick bark. Several people present stated that scales could be found on large trees with plated bark if the plates were removed. The scales are capable of building up under the plates where the bark is relatively thin.

Maple bark scale exhibits a preference for small trees 1-6 inches DBH. They have, however, been found on trees over 16 inches DBH. Color of the trees apparently has no influence on degree of infestations. The scales, with a white waxy covering, are more easily observed on dark trees.

Maple bark scale can be found on most above ground portions of trees. Apparently no scales have ever been found on the twigs. Infestations are heavier 4-6 feet from the ground than at the root collar. This is probably due to the thicker bark at the base of trees. Very few people have ever felled trees to examine the crowns. Hadfield reported observing scales 25-30 feet up heavily infested stems.

Infestations are heaviest on the northeast portions of trees; the lightest infestations occur on the south. The cause of this is not known although it appears that light or temperature might

influence the scale. When infestations become light to medium on the northeast portions of the trees, the scales spread around the entire circumference although they remain heaviest on the northeast.

PARASITES AND PREDATORS

Two species of parasites have been found on adult maple bark scales. Only one has been reared through to adult stage. It has been identified as a Coccophagoides, a parasitic wasp. This wasp is apparently quite host specific; no record is available of its occurrence on any other insect. Parasitism appears to be widespread throughout New Hampshire. In one sample 33% of the scales examined were parasitized. Arthur Mason feels parasitism is high enough to hold down maple bark scale populations in New Hampshire. Parasitized scales are orange. Parasite emergence occurs about the same time as crawler emergence.

Predators suspected of feeding on maple bark scale include: Lampyridae; lacewing fly larvae (Chrysopidae); Syrphid fly larvae (Syrphidae); and twice-stabbed lady beetles (Chilocorus stigma).

A question was asked about the influence of cold temperatures upon survival of the adult scales. Frequently, the protective wax is washed off exposing the scales to freezing temperatures. People from Vermont and New Hampshire did report a drop in scale population levels in 1968 following the severe winter of 1967-68. No one knows what temperatures are required to kill the overwintering adults. Another point was made that perhaps the crawlers are susceptible to late spring frosts.

DISTRIBUTION

Distribution surveys were initiated shortly after maple bark scale was rediscovered in 1965. A survey form was prepared by the joint efforts of the Forest Service and several states. This form has fallen into disuse. Form 1.

Surveys conducted by Vermont Department of Forests and Parks have shown maple bark scale is distributed over the entire state. Surveys conducted by the New Hampshire Department of Agriculture and the Department of Resources and Economic Development indicated similar results in that state. The scale is difficult to find in southeastern New Hampshire because of the lack of large blocks of sugar maple in that area.

No formal surveys have been initiated in New York or Maine, but the scale has been found in both states. The scale has not been observed in Massachusetts or Connecticut.

Maple bark scale was reported in Sault Ste. Marie, Ontario, and Quebec, Canada.

It became apparent at the Workshop that no one knew what actual percentage of sugar maples within the surveyed areas were infested. There is a basic reason for this. Surveyors looking for maple bark scale quickly develop the ability to recognize trees which are likely to be infested. Naturally, during a delimiting survey, such trees are favored. Probably less than 2% of sugar maples are infested in the New England area. Figure 1 depicts the known distribution of maple bark scale in the United States.

STUDY PLOTS

Vermont Department of Forests and Parks has established study plots. One type of plot is designed to measure rate and direction of infestation spread. A "focus" tree with a relatively heavy infestation serves as the center of the plot. Surrounding trees are examined in a clockwise direction from the center tree. As surrounding trees become infested or as their infestations change in degree, this is recorded. Bark thickness is recorded on these plots. Data will be collected for at least 5 years. Another type of plot consists of single trees with heavy infestations. These trees are examined every year for changes in infestations, symptoms of tree stress, and disease signs. A third type of plot uses a delineated area on an infested tree. This area is photographed every year. Photographs of the infested trees have been used to establish the infestation catagories of trace, light, medium, and heavy. The slide series (Figure 2) prepared by E. Bradford Walker has been distributed to others who have worked with the scale.

The Amherst Field Office has established four study plots on the Green Mountain and four on the White Mountain National Forests. These plots have four objectives.

1. To determine what, if any, damage maple bark scale infestations cause.

2. To determine if maple bark scale infestations create infection courts for pathogenic organisms.

3. To determine what tree and stand factors influence maple bark scale populations and which of these factors characterize trees infested by the scales.

4. To serve as demonstration areas for personnel who want to familiarize themselves with the insect. The plots are circular and 1/5 acre in size. A heavily infested tree serves as the center. All

maples within the plot are numbered consecutively in a clockwise direction starting in the north. Four, square-inch plots are painted at each cardinal direction at heights of 2.5, 4.5, and 6.0 feet from the ground. Bark characteristics, DBH, and vigor of all trees are recorded on prepared Forms 2 and 3. Infestations within the painted squares are classified as none, trace, light, medium, and heavy following the slides prepared by Walker. Although observations have been made only three times on each plot, some definite conclusions have been made concerning infestations in relation to cardinal direction, DBH, and height on the bole (Tables 1, 2, 3, and 4). Heaviest infestations occur in squares on the north and east. Infestations are most prevalent on trees 2-5 inches DBH, and infestations are more prevalent on the highest set of squares at 6.0 feet.

An interesting, unsuspected phenomenon occurred on these plots. The sample squares were delineated on the trees with orange tree marking paint. One year after the paint had been applied it was observed that the scale population was increasing on the orange paint while decreasing on the unpainted surface inside the squares. The insects seemed to prefer the painted surfaces.

MAPLE BARK SCALE - NECTRIA STUDY

In August 1968 Hadfield and McCowan of the Amherst Field Office discovered Nectria perithecia on maple bark scale infested trees on the White Mountain National Forest. The Amherst Field Office conducted a survey of the Green Mountain and White Mountain National Forests in the fall of 1968 to determine if Nectria perithecia could be found on other scale infested maples. A total of five infested trees were found with Nectria perithecia. Over 4,400 trees were examined, and 5.25% of the trees had scale infestations. The report issued on the surveys emphasized that Nectria perithecia were found only on trees which had tissue killed by other agents. In no instance could Nectria definitely be associated with maple bark scale infestations.

NECTRIA INOCULATIONS

A series of inoculations using Nectria coccinea var. faginata were conducted by Hadfield to determine if maple bark scale could provide infection courts for this fungus. All inoculations were performed at the Chittenden Brook Campground, Green Mountain National Forest.

Several types of inoculations were used. Maple and beech were inoculated with N. coccinea grown on agar, and sterile agar was used as a check treatment (Table 5). Infested maple and beech were inoculated with beech bark bearing N. coccinea perithecia, and healthy bark was

used as a check (Table 6). Uninfested maple and beech were wounded by three methods. The wounded trees were then inoculated by two techniques (a) with perithecia on beech bark, and (b) with a water suspension of mycelium and spores. Healthy beech bark and sterile water were used as checks (Table 7).

The inoculations were applied during the week of May 12, 1969. One half were collected during the week of August 11, 1969. The remaining inoculations will be examined in May 1970.

Nectria was reisolated from only one maple, a tree which had been inoculated with an agar culture placed under the bark. In contrast several Nectria reisolations were made from beech. As a result of this study, it seems unlikely that maple bark scale can cause wounds capable of being invaded by Nectria.

OTHER STUDIES

Dr. David Houston, NEFES, reported that he had made histological sections of maple infested by scale to determine if the feeding wounds could provide entrance courts for pathogens. He reported that no damage could be seen on areas infested by the insect.

POTENTIAL FOR DAMAGE

As a result of the information presented, it was generally agreed that maple bark scale, as it is now known, does not represent a threat to sugar maple.

Several thousand trees have been examined and no one has ever seen any tree stress which could be attributed to maple bark scale. The insect has probably been around for a long time as evidenced by the wide distribution over a large area. That it has well established parasites also indicates it has been present for many years. If it has been around for many years, ample opportunities have probably occurred for damage to appear if one assumes the scale does cause stress or create infection courts for pathogens.

Histological sections revealed no damage to tissue upon which the scales were apparently feeding. No damage indicates maple bark scale is not a problem.

PLANS FOR THE FUTURE

The following plans were made at the Workshop:

1. The New Hampshire Department of Agriculture will continue to study the parasites of maple bark scale.

2. Single, heavily infested trees will be observed for symptoms of stress by the states represented and the Amherst Field Office. Data will be recorded on the existing field observation report (Form 1).

3. Amherst Field Office and Vermont Department of Forests and Parks will continue observations on their study plots.

4. The Green Mountain and White Mountain National Forests will instruct their personnel to report sightings of heavily infested maples.

5. Research will attempt to conduct more histological studies of infested maples.

6. Research will closely follow the progress of all study plots.

7. Vermont Department of Forests and Parks, time permitting, will work on the life cycle of maple bark scale.

8. Amherst Field Office will ask other federal Forest Pest Control Field Offices to determine if maple bark scale is present in the areas they serve.

APPENDIX

Form 1

FIELD OBSERVATION REPORT
MAPLE BARK SCALE

REPORTER _____ STATE (NAT. FOR.) _____ DATE _____
TOWNSHIP (Describe Location _____

STAND CHARACTERS:
% Sugar Maple (Check): Less than 25% ____ 25-50% ____ Over 50% ____ Pure ____
Dominant Diameter (Sugar Maple): 2-5" ____ 6-11" ____ 12"-over ____
Crown Closure (Check): Open ____ Intermediate ____ Closed ____
Physical Characters (Check):

Elevation	Exposure Aspect	Inclination	Sugar Maple
0-500' ____	North ____	Flat ____	Even Aged ____
500-1000' ____	South ____	Valley ____	2-storied ____
1000-1500' ____	East ____	Slope ____	All Aged ____
1500-2000' ____	West ____	Ridge Top ____	
2000-over ____			

Other Observations (i.e. Major Tree Association): _____

TREE AND SCALE INFORMATION (On Individual Trees):

Tree No.	1	2	3	4	5	6	7	8	9	10
DBH (inch)										
Crown Class										
Bark Character										
Position in Stand										
Scale - Stage										
Degree Infestation										
Aspect on Tree										
Niche Type										
Parasitism										
Predation										
Associated Disease										

Table Code:
DBH: Record to nearest 0.5 inch
Crown Class: D-Dominant, C-Codominant, I-Intermediate, U-Understory
Bark Character: R-Rough, S-Smooth (on main stem), F-Flaking
Position in Stand: E-Edge of Stand, I-Interior, R-Roadside
Insect Stage: S-Settled, C-Crawler
Degree Infestation: T-Trace, L-Light, M-Medium, H-Heavy
Aspect on Tree: N-North, S-South, E-East, W-West
Niche Type: BC-Bark Crack, BA-Branch Axis, W-Wound, L-Lichen (Moss), O-Other (Describe below)
Parasitism: Yes, No, X-No Observation Made
Predation: O-Seen Working, X-No Observation Made
Associated Disease: Record information on tree disease symptoms which may be attributed to scale infestation (below or on reverse side) (bark lesions, cankers on trunk, branch dieback, abnormal foliage color or size, etc.)

Other Observations: _____

Form 2

Plot No. _____ Plot Established _____

Established by _____ Location _____

Stand Data

Aspect _____ Elevation _____

Drainage _____ Percent Sugar Maple _____

_____ Date

Basal area _____ Percent crown closure _____

Health _____

_____

Comments _____

_____

_____ Date

Basal area _____ Percent crown closure _____

Health _____

_____

Comments _____

_____

_____ Date

Basal area _____ Percent crown closure _____

Health _____

_____

Comments _____

_____

_____ Date

Basal area _____ Percent crown closure _____

Health _____

_____

Comments _____

_____

Form 3

Plot No. _____ Quadrant _____ Tree No. _____

DEGREE OF INFESTATION None N Trace T Light L Medium M Heavy H

2.5 Feet

N											
E											
S											
W											

Date ____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____

4.5 Feet

N											
E											
S											
W											

Date ____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____

6.0 Feet

N											
E											
S											
W											

Date ____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____

HEALTH Dead D Dying Dy Poor Vigor PV Good G

_____ 1968 ____; _____ 1969 ____; _____ 1970 ____; _____ 1971 ____;
_____ 1972 ____; _____ 1973 ____; _____ 1974 ____; _____ 1975 ____.

DBH _____ 1968 ____; _____ 1969 ____; _____ 1970 ____; _____ 1971 ____;
_____ 1972 ____; _____ 1973 ____; _____ 1974 ____; _____ 1975 ____.

BARK CHARACTERISTICS Thin and smooth TS Beginning to crack BC Plates beginning to form P Rough and thick R Thick with plates TP

1968 ____ 1969 ____ 1970 ____ 1971 ____ 1972 ____ 1973 ____ 1974 ____ 1975 ____

Predators

_____ 1968 _____ _____ 1972 _____
_____ 1969 _____ _____ 1973 _____
_____ 1970 _____ _____ 1974 _____
_____ 1971 _____ _____ 1975 _____

CANKERS Nectria N Fusarium F Other O Absent A

1968 ____ 1969 ____ 1970 ____ 1971 ____ 1972 ____ 1973 ____ 1974 ____ 1975 ____

FIGURE 1

Distribution of Maple Bark Scale
Cryptococcus williamsi in the United States

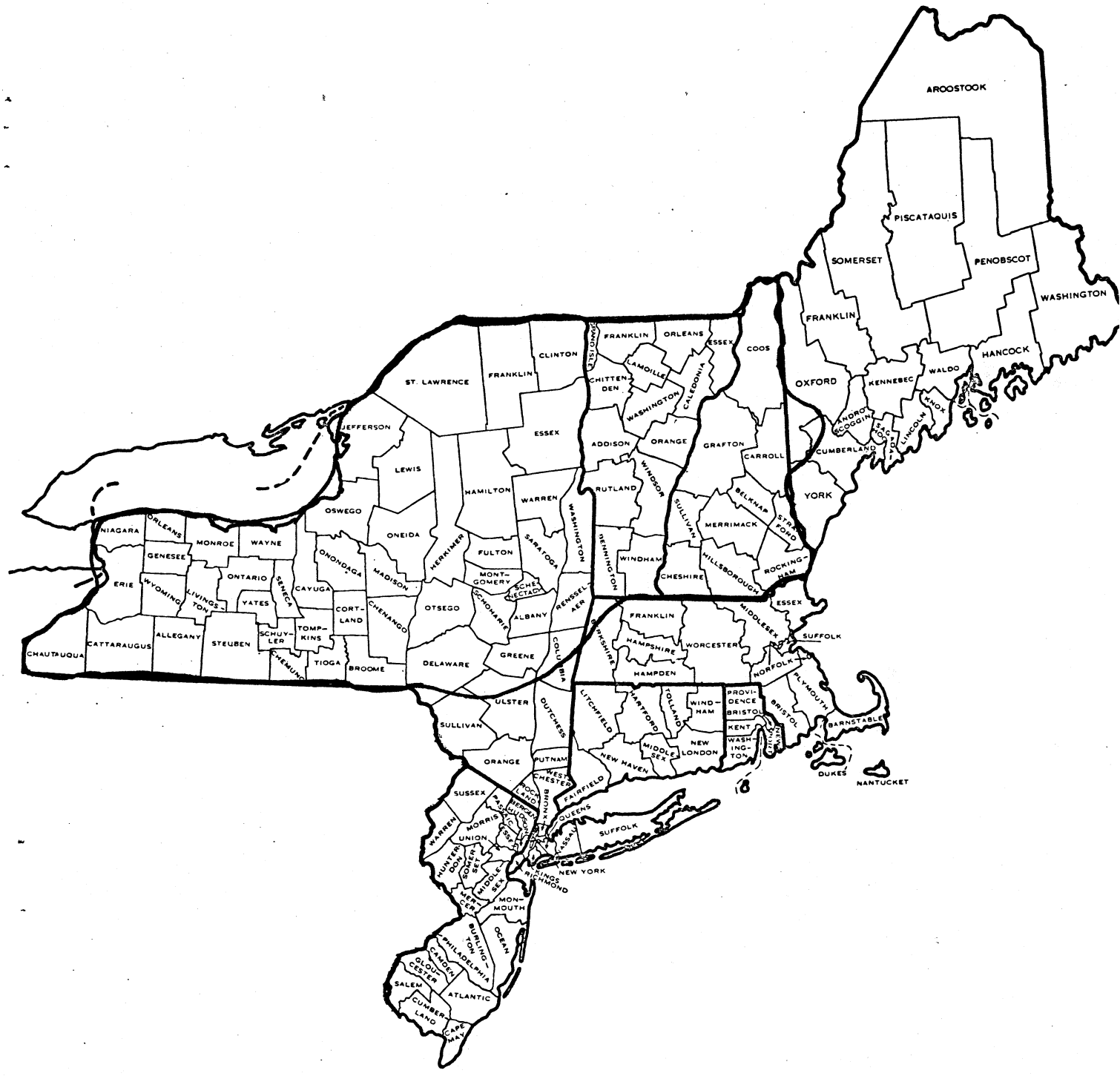

FIGURE 2

Degree of Maple Bark Scale Infestations

Walker Slide Series

Trace - Insects not clustered cannot be seen from 4-5'.

Light - Some clustering. Infestations cannot be seen at 8-10'.

Medium - Bark crevices filled.

Heavy - Crevices filled, some scales on ridges of bark.

TABLE 1

Maple Bark Scale Infestations in Relation to Cardinal Direction of Sample Squares on Eight Observation Plots on the Green and White Mountain National Forests

	Number of Squares Infested				
Direction	None	Trace	Light	Medium	Percent Infested
North	679	136	17	4	18.8
East	674	143	18	1	19.4
South	705	115	13	0	15.4
West	703	117	14	2	15.9
Total	2761	511	62	7	17.4%

Squares at 2.5, 4.5, and 6.0'

TABLE 2

Maple Bark Scale Infestations in Relation to DBH on Eight Observation Plots on the Green and White Mountain National Forests

DBH	Number of Trees Infested				Percent Infested
	None	Trace	Light	Medium	
<2.0	73	35	1	0	33.0
2.0 - 3.5	58	47	7	1	48.7
3.5 - 5.0	36	21	5	2	43.7
5.0 - 6.5	30	9	0	0	30.0
6.5 - 8.0	10	0	0	0	0
>8.0	14	1	0	0	6.7
Total	221	113	13	3	37.1%

TABLE 3

Maple Bark Scale In Relation to Height of Sample Square on Eight Observation Plots on The Green and White Mountain National Forests

Height of Squares	Number of Squares Infested				
	None	Trace	Light	Medium	Percent Infested
2.5'	928	921	14	3	10.7
4.5'	993	198	21	2	18.2
6.0'	903	219	27	2	21.5
Total	2,824	511	62	7	17.0%

TABLE 4

Maple Bark Scale Infestations in Relation To
Bark Characteristics on Eight Observation Plots
On The Green and White Mountain National Forests

Bark Characteristics	Number of Squares Infested				Percent Infested
	None	Trace	Light	Medium	
Thin and Smooth	110	47	4	1	32.1
Beginning to Crack	36	26	5	0	46.3
Plates Forming	11	1	0	0	9.1
Rough, Thick	14	1	0	0	6.7
Thick Plates	22	0	0	0	0
Total	193	75	9	1	30.6

TABLE 5

Inoculation of Maple and Beech with *Nectria coccinea* Mycelium on Malt Extract Agar

	Nectria Reisolated	
	Treatment	Control
Maple	4(-) 1 (+) *	5(-)
Beech	1(+)	1(-)

* + = *Nectria* reisolated

\- = *Nectria* not reisolated

TABLE 6

Nectria coccinea Inoculations on Beech and Maple Wounded by Three Methods

Species	Nectria Reisolated					
	Puncture-check		Slit-check		Blow-check	
	Nectria perithecia Inoculum					
Maple	4(-)	3(-) *	4(-)	2(-)	4(-)	0
Beech	1(-)	0 **	1(+)	0	1(+)	0
	Nectria Mycelium-spore Suspension Inoculum					
Maple	4(-)	2(-)	4(-)	1(-)	4(-)	1(-)
Beech	2(-)	2(-)	2(-)	0	2(-)	0

* + = *Nectria* reisolated

\- = *Nectria* not reisolated

** No check treatments examined

TABLE 7

Sugar Maple Inoculated with Nectria coccinea perithecia on Beech Bark

	Isolations		
Infested Maple	53 Bacteria	10 Trichoderma	17 Nothing
Uninfested Maple	1 Bacteria	1 Unknown fungus	13 Nothing

Sugar Maple Inoculated with Healthy Beech Bark

	Isolations	
Infested Maple	5 Bacteria	15 Nothing

Two scale infested beech were inoculated with Nectria coccinea perithecia on beech bark. Nectria was reisolated from one beech.